THE AMERICAN MINERALOGIST
JOURNAL OF THE MINERALOGICAL SOCIETY OF AMERICA

VOL. 8 SEPTEMBER, 1923 No. 9

THE SCAPOLITE DEPOSIT OF BOLTON, MASSACHUSETTS

C. PALACHE AND A. W. PINGER, *Harvard University*

The mineral deposit at Bolton, known by collectors and in mineralogic literature for nearly a century, is still worthy of a visit although fresh exposures of the rocks have not been made for many years. The locality is an abandoned limestone quarry situated a few hundred yards from the road between Stow and Lancaster, in the town of Bolton, about 25 miles west and slightly north of Cambridge. The present owner of the farm on which the quarry is located is S. B. Mentzger whose farm is on the roadside, about one mile east of the junction of the road from Hudson, the nearest railroad station, three miles southeast.

A general account of the geologic relations of the deposits may best be found in Emerson's Geology of Massachusetts, Bull. U. S. G. S. 597. It is one of a roughly linear series of small lenses of metamorphic limestone distributed over a distance of some 20 miles northeast from Bolton to Chelmsford. The limestone bodies are enclosed in a gneiss of unknown age; Emerson regards it as probably Carboniferous but Keith and LaForge are quoted by him as assigning it to a much older horizon, probably Cambrian.

The actual relations which may be observed at the larger, water-filled quarry are these:—the gneiss which forms the summit of the hill behind the quarry strikes NNE-SSW and dips steeply to the east; the limestone is conformable to the gneiss and beneath it. Between gneiss and limestone and exposed on the vertical wall of the quarry are several layers of varying mineral composition. Next to the gneiss is a layer of massive pink scapolite, lenseshaped, and reaching a thickness of 16 feet at one point. Next below this is a layer of diopside-actinolite rock grading downward into a zone of boltonite-rich limestone and through that into normal limestone. The limestone is magnesian, almost a dolomite in composition, generally gives a fetid odor on fracture, and is coarsely crystalline in texture. There is an abundance of coarse granite pegmatite boulders in the immediate neighborhood of the quarry but the rock could not be discovered in place. In other pits to the SW, however, dike-like masses of quartz and scapolite which have been left standing in the excavation of the limestone give the impression of being igneous in nature and are interpreted as scapolite pegmatites. And it is believed that the formation of scapolite on the unusually large scale here exhibited is due to the action of pegmatite intrusions upon the materials of the gneiss-limestone contact zone.

The two minerals of most interest at this locality are scapolite and boltonite, a variety of forsterite. The best materials for the study of these minerals are now to be found in the collections of the Boston Society of Natural History which, by the acquisition of the Brigham collection, obtained what is undoubtedly the best series of Bolton specimens which has been preserved.

SCAPOLITE. The typical Bolton scapolite is massive but coarsely crystalline, in aggregates of columnar individuals which may be as much as two feet in length and six inches or more in diameter. On fracture and weathered surfaces these individuals are marked by their cleavage parallel to the prism. The color is pinkish-lilac shading to a lighter tone on the borders of the crystals. The freshest materials, and especially the centers of the larger crystals are clear and glassy. A polished block in the Harvard Mineralogical Museum with a surface of at least two feet is very decorative and suggests the possibility of using the material as an ornamental stone. Blocks of even larger dimensions, quite free from any admixture of other minerals, could be undoubtedly obtained, but it would be necessary to do the quarrying in winter when the deep quarry pool is frozen. The wall where the fresh scapolite is exposed is vertical and it is with utmost difficulty that at other times material can be broken from the ledge and saved from falling into the water below.

Scapolite also occurs in well formed rough crystals which are generally imbedded in quartz. These crystals which may reach a diameter of two inches and a length of four inches or more are generally simple prisms of the first order, rarely well terminated but sometimes showing the unit pyramid, with or without the basal pinacoid. Such crystals are generally opaque and white or grayish in color. The Brigham collection contained a great many of these distinct crystals but they are no longer to be seen at the quarry. The old dumps, formerly rich in large blocks of massive scapolite, have been so long worked over by visiting mineralogists and have become so overgrown by shrubbery that it is now difficult to secure specimens of typical material from them.

The mineral early described from here under the name of nuttallite proved to be merely a variety of scapolite.

BOLTONITE. Under this name was early described a variety of forsterite which is abundant at Bolton. It is found in limestone in small scattered grains or making up a considerable part of the rock. It is smoky gray to colorless and the grains are mostly small but reach a size such that prismatic sections are two inches long by half an inch across. The analyses of boltonite to be found in Dana's System show it to be a lime-free forsterite with a low content of ferrous iron. It easily undergoes alteration to serpentine, the first change resulting in giving it a yellowish color not unlike that of the chondrodite with which it is associated. Its good cleavage (pinacoidal) furnishes a good means of recognition in the hand specimen.

It is associated commonly with diopside and actinolite, more rarely with chondrodite, apatite and titanite. Scapolite is rarely found with it.

OTHER MINERALS. A number of other minerals are found in the Bolton locality but none is of special note. The observations which follow are drawn from a paper prepared by A. W. Pinger who studied the collections at the Boston Society of Natural History as well as those at Harvard and visited the locality more than once.

FELDSPARS. The feldspar at Bolton is chiefly microcline, found in the pegmatites in association with scapolite, and phlogopite mica. Andesine has been described by Emerson as occurring in limestone with pyroxene. The scarcity of feldspar in the pegmatites is probably to be explained by the abundance of scapolite which has seemingly taken its place.

PYROXENE. The only pyroxene is diopside which is abundant in the limestone in company with actinolite, apatite and titanite. It is commonly granular but may form large individuals with platy basal parting. In cavities filled with later calcite it forms small crystals of ordinary diopside habit, together with later fibrous actinolite. These are pale green or greenish white in color and sometimes transparent.

Much of the platy diopside in collections was found under the label petalite.

Actinolite is the only amphibole determined. It forms dark to light green needles filling the limestone rock or radiating into calcite-filled cavities together with diopside. It seems to have formed after diopside but not as an alteration of it.

Zircon was determined as microscopic inclusions in gray scapolite.

Allanite was seen in numerous specimens as grains surrounded by a strained zone caused by increase of volume on alteration. All material examined under the microscope was isotropic with an index of 1.68 in the freshest grains. It was found in scapolite rock, in limestone and in the minerals characteristic of the latter.

Garnet in reddish crystals in scapolite rock was sparingly observed; probably essonite.

Chondrodite in vivid yellow grains was seen not uncommonly in the boltonite rock.

Mica, both dark and light brown in color, is sparingly present and is thought to be phlogopite. The lighter varieties are disseminated in the limestone; the darker ones in granular masses along the contact of the pyroxene and scapolite rock layers.

Serpentine and talc form alteration products after forsterite, chondrodite and diopside. They are not abundant and exhibit no noteworthy characters.

Titanite in brownish crystals is widely and fairly abundantly distributed throughout the deposit, chiefly however in the pyroxene zone. The crystals reach a diameter of one inch and have the usual flat lense shape; small crystals are quite complex but most of them have been shattered by pressure and show pronounced pressure twinning. In cavities containing diopside crystals cleancut crystals of titanite are sometimes present. These cavities are marked by having a filling of granular calcite, removal of which with dilute acid reveals the crystalline lining of the walls.

Petalite has long been recorded as occurring at Bolton and Dana gives an analysis of this mineral from there. Many specimens labelled petalite were examined in both collections studied but none of them proved to be correctly identified. They included platy diopside, microcline, scapolite, and especially a fine grained form of partially altered massive scapolite mixed with calcite. It seems probable that the petalite originally found here was from an erratic similar to the spodumene boulder found in Sterling, Massachusetts.

Graphite and magnetite both occur sparingly in thin veins in the gneiss, and in altered scapolite rock.

Spinel in small blue-gray octahedrons occurs in the limestone in the usual close association with chondrodite.

Rutile, doubtfully identified as rod-like inclusions in gray scapolite, and quartz, abundant in massive form in the pegmatite, complete the list of oxide minerals recognized.

Sulphides sparingly present in minute grains in the limestone include arsenopyrite, chalcopyrite, pyrite, and pyrrhotite. The first three were identified by crystal form under the binoculars as well as by other tests.

Apatite of a pale green color is common throughout the deposit in crystals ranging in size from microscopic needles to prisms three inches in length. It was seen in massive scapolite, in boltonite rock, and in druses with titanite and diopside. It appears always to have formed at an early stage of crystallization. Some gray crystals contain the rod-like inclusions thought to be rutile also seen in scapolite.

Fluorite, yttrocerite and cerium ochre are names of minerals reported from Bolton but not identified in the collection studied.

THE FORMATION OF KAOLIN AT MODERATE DEPTHS[1]

A. L. Parsons, *University of Toronto*

In an intelligent discussion of the formation of kaolin it is necessary to consider the minerals from which kaolin may be formed, the reagents that will change these minerals to kaolin, the source of these reagents, and the minerals that will be formed simultaneously with the kaolin.

In the present paper the writer will attempt to indicate the type of minerals from which kaolin may be formed with an outline of the probable reactions and a summary of the results of some of the reactions. In addition attention will be drawn to two kaolin deposits which in his opinion are due almost entirely to the action of carbon dioxide and surface water.

---

[1] Read at the meeting of the Mineralogical Society of America, Ann Arbor, Michigan, Dec. 29, 1922.

Inasmuch as kaolin is a hydrous silicate of alumina it is at once evident that the original material must contain aluminium and silica and observation has shown that the feldspars and feldspathoid minerals are the principal ones involved. Under some conditions the micas may be concerned though it is difficult to conceive of muscovite as a source of kaolin in view of its well known resistance to acids.

To account for the formation of kaolin it is necessary to provide an acid reagent which together with water will remove the alkaline element and hydrate the aluminium silicate. Simple hydrolysis has been suggested by some writers but the reactions given leave the feeling that granite ought not to outcrop on lakes and rivers if this is a serious factor. It may be argued that this reaction is effective only under pressure, but in that case it may be eliminated as an important factor in this discussion which deals only with deposits of moderate depth, that is not more than six hundred feet.

The possible acids that may be involved are sulphuric, nitric, hydrofluoric, hydrochloric, phosphoric, boracic, carbonic, and hydrogen sulphide. Certain humous acids are also suggested in the case of fire clays underlying coal deposits. Of these, nitric and boracic acids are probably best eliminated as serious factors in view of the low percentage of nitrates and borates commonly found in surface waters, either lake, river, or ocean. Such borates, or borosilicates as are found in kaolin deposits give no evidence of having been connected with the formation of kaolin (e.g. tourmaline).

Phosphoric acid is more abundant but is usually combined with lime, and is associated with the feldspars in the form of apatite which crystallized before the feldspar so that we must conceive of peculiar conditions that would permit of a reaction that would permit phosphoric acid to be active as a kaolinizing agent. Another discouraging factor in this connection is the remarkably small percentage of phosphoric acid present in the ordinary feldspathic rock. In case, however, there were a phosphate deposit in contact with an igneous rock a reaction that looks possible, in case nothing were present but the feldspar and phosphate, is as follows:

$$Ca_3P_2O_8+6KAlSi_3O_8+6H_2O=K_6P_2O_8+3H_4Al_2Si_2O_9 \\ +3CaSiO_3+9SiO_2$$

Kaolin is supposed by some writers to be due to sulphate solutions and an examination of the analyses of river and lake waters gives some ground for this supposition, but when the solubilities of sulphates, chlorides, and carbonates of lime, magnesia, soda and potash, are considered it is at once evident that except when the water drains an igneous region such data are of little value in determining the acid that is of most importance in the kaolinization of a feldspar.

Lindgren[2] in advocating the influence of sulphuric acid in the formation of kaolin indicates rather definitely that kaolin is not formed by metasomatic action as at depth sericite and carbonates are found, while nearer the surface sericite and adularia occur and only still nearer the surface is kaolin found. His mention of alunite as one of the minerals in this upper region, however, rather weakens his argument for sulphuric acid as a kaolinizing agent.

The fundamental fact in this connection appears to be that the common soluble sulphates that may be considered are ferrous and ferric sulphates which would necessitate either the precipitation of ferric oxide with the solution of the alkali or the substitution of the iron for the alkali. In the case of a pure white kaolin deposit neither of these conditions is permissible. Gypsum is out of the question as a reagent although it may form as a result of the action of sulphates on lime feldspar, possibly with the simultaneous formation of kaolin. The normal reaction when sulphate solutions attack orthoclase so far as observed by the writer result in the formation of alum or alunite and silica without kaolin. This is the reaction involved in the production of the "Iron Hat."

In the case of the chloride solutions it must be noted that free hydrochloric acid is extremely rare and there is a tendency for chloride solutions to become rich in soda at the expense of potash without marked kaolinization. This is well shown by the action of Sonstadt's solution on certain zeolites[3] and is probably the principal reason for the low potash content of sea water.

The action of hydrofluoric acid is suggested by some writers. This is possible but highly improbable as an important factor as it necessitates deposits of fluorides commensurate with the kaolin deposits. Collins[4] prepared kaolin artificially by means of hydro-

[2] Mineral Deposits, p. 457.

[3] Walker, T. L., *Am. Min.*, 7, 100-102, 1922.

[4] Collins, J. H., *Min. Mag.*, *VII*, p. 213.

fluoric acid with the simultaneous formation of potassium fluoride and silica. No suggestion is given as to later reactions of the potassium fluoride on the rocks if this reaction occurs in nature. Inasmuch as potassium fluoride is unknown and hieratite is one of the extremely rare minerals it seems better to look for a more satisfactory reaction. In case anorthite were the feldspar two parts of hydrofluoric acid and one part of water would suffice to form fluorite and kaolin. The presence of fluorite and topaz in kaolin cannot, however, be looked upon as proof that the hydrofluoric acid was involved in the formation of the kaolin. With our knowledge that fluorite granite is not uncommon it requires definite proof that the fluorite is secondary. It is also difficult to conceive what reactions would result in the simultaneous formation of topaz and kaolin. Certainly the fluorine that is involved in the formation of topaz is not to be considered as a kaolinizing reagent.

The one common acid that remains to be considered is carbonic, which in the writer's opinion is responsible for most of the kaolinization that is shown by surface deposits. The extension of this reaction to depth requires explanation, for the writer has observed the results of this reaction at a depth of 540 feet. It will extend just so far as there is free circulation of water and just so long as there is a supply of carbonic acid. It can hardly be expected that the small quantity of carbonic acid that would be carried into a fissure by rain water will have a very pronounced effect. The effect will be directly proportional to the quantity of water and carbonic acid. If there is a source of carbonic acid that can be drawn upon to supplement that brought in by rain the action will be more extensive.

In the case of the kaolinized diabase dyke at the Helen iron mine which has been described by the writer, the reaction resulted from the oxidation of a large body of siderite which set large quantities of carbonic acid free while the iron formed goethite.[5] This dyke is completely kaolinized at a depth of 300 feet and at the sixth level (about 450 feet) partial kaolinization was observed. On the surface at the edge of the iron ore body the diabase is perfectly fresh and no trace of decomposition was observed. At a depth of 540 feet another body of kaolin was found where the wall rock of feldspathic sericite schist had been kaolinized. In this

[5] *Ont. Bur. Mines, XXIV* Ann. Rep. 1915, Pt. 1, pp. 192-194, and 202-204.

case the recalculation of the analysis shows almost equal parts of kaolin, sericite, and quartz, with about seven percent of goethite, thus showing rather conclusively that the feldspars are more liable to kaolinizing agencies than sericite or muscovite. Chemical activity was rather marked as the ore was warm to the touch and steam was abundant in the lower levels. The mine waters carried certain iron sulphates as a result of the oxidation of pyrite, and this might give rise to the idea that sulphate solutions were the cause of the kaolinization, but as the siderite has been completely oxidized and only a small part of the pyrite has been oxidized and the percentage of pyrite is usually quite small it seems unreasonable to give undue prominence to the action of the sulphates.

The second of these deposits at the Helen mine verges on the deep seated type of some writers as it is more than one hundred feet deeper than the workings at the Cornwall kaolin mines.[6]

In the case of the kaolin deposits at Huberdeau, Quebec, the source of the carbonic acid would appear to the writer to be a crystalline limestone which is separated from the kaolinized granite and gneiss by a shattered quartzite. Even with the extent of the quartzite the amount of carbonic acid that would be normally introduced from the surface can hardly be looked upon as a sufficient explanation of the very complete kaolinization that is known to extend to a depth of one hundred feet as shown by the workings. In this case it would appear to the writer that in addition to the normal reaction resulting in the formation of potassium carbonate, kaolin and metasilicic acid there was a reaction between the metasilicic acid and the limestone with the formation of diopside or wollastonite and carbonic acid which supplemented the CO_2 in the rain water which gained access to both types of rock through the porous quartzite. In the quartzite there are frequent particles of kaolin which has given rise to the idea that the kaolin must have been brought in probably from below. In view of the frequent presence of feldspar in sandstones and sands this idea seems unnecessary to explain the presence of kaolin in quartzite.

In case it is granted that carbonic acid is ever active in the process of kaolinization it would seem to the writer that in these two cases the ideal conditions exist for it to be most effective, for there is a large potential supply of carbonic acid, there is plenty of water (both mines are wet). In the first case the acid is released by oxidation of iron carbonate. In the second case it is assumed that a reaction that is usually attributed to contact metamorphism can also take place in the wet way at a temperature low for metamorphism but yielding products that are warm to the touch.

---

[6] Ries, H., Clays, Their Occurrence, Properties and Uses, Second Ed., p. 6, 1908.

STANNITE, ITS ASSOCIATED MINERALS AND THEIR PARAGENESIS

G. M. Schwartz, *University of Minnesota*

Introduction

Recently in examining polished surfaces of stannite with a reflecting microscope the writer was impressed by the variety of included minerals, and by the uniform nature of the associations in specimens from the various districts. Further studies were made on all the available specimens with the results noted here. The writer is indebted to Dr. E. Steidtmann of the University of Wisconsin for the use of some of the material.

Occurrence of Stannite

Stannite is listed in textbooks of mineralogy as a rare mineral due to its known occurrence in but few districts. However, it occurs in considerable amounts locally in these districts especially in Bolivia. Dana[1] lists stannite from several places in Cornwall, England, Zinnwald in the Erzgebirge, and the Cronebare Mine, County Wicklow, Ireland; also from Bolivia and the Black Hills, S. D. It has been described from Tasmania and Australia,[2] from the Bolivian[3] tin-silver deposits, and from one locality on the Seward Peninsula, Alaska.[4]

---

[1] Dana, E. S., System of Mineralogy. Sixth Edition, p. 83 and App. I.

[2] Andrews, E. C., The Geol. of the New England Plateau, New S. Wales. *Geol Sur. Rec.*, **8**, 146, 1905.

Hartwell, C. The Occurrence of Stannite in Australia. *Australian Min. Standard*, **10**, 577, 1908.

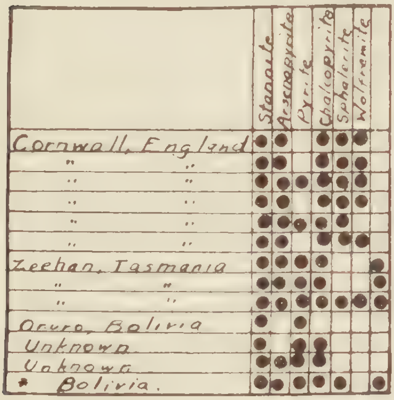
Petered, W. F., Catalogue of the Minerals of Tasmania, *Tasmanian Dept. of Mines*, 67, 1910.

[3] Stelzner, A. W., Die Silber-Zinnerzlagerstatten Bolivias. *Z. deut. Geol. Ges.*, **49**, pp. 53-142, 1899.

Singewald, J. F. and Miller, B. L. The Mineral Deposits of South America. McGraw-Hill Book Co., **1919**.

[4] Knopf, A., Geol. of the Seward Peninsula Tin Deposits. *U. S. Geol. Sur.*, Bull. **358**, 18, 1908.

Stannite has been noted to occur with pyrite, arsenopyrite, chalcopyrite, cassiterite, wolframite, galena, sphalerite, etc. Davy[5] has given an especially complete description of its associations in the Bolivian deposits. The polished surfaces examined in this study were on specimens from Cornwall, Tasmania, and Bolivia. The following opaque minerals were found included in the stannite; pyrite, arsenopyrite, chalcopyrite, sphalerite, wolframite, and frankeite. The table in Figure 1 shows the associations in the various specimens. Other minerals occur with stannite, but only those found included in it are discussed in this paper. It was found that there is a fairly definite paragenesis of the minerals noted and this agrees essentially with that given by Davy for the Bolivian deposits.



	Stannite	Arsenopyrite	Pyrite	Chalcopyrite	Sphalerite	Wolframite	
Cornwall, England	●	●		●	●	●	
" "	●	●		●	●	●	
" "	●	●	●	●	●	●	
" "	●	●		●	●	●	
" "	●	●	●	●	●		
" "	●	●		●	●	●	
Zeehan, Tasmania	●	●	●	●			●
" "	●	●	●	●			●
" "	●	●	●	●	●	●	●
Oruro, Bolivia	●		●				
Unknown	●		●	●			
Unknown	●	●	●	●			
* Bolivia.	●	●	●	●	●		●

FIG. 1. Shows in tabular form the minerals found as inclusions in stannite from various regions. (*) From Davy, *Econ. Geol.*, **15**, 491.

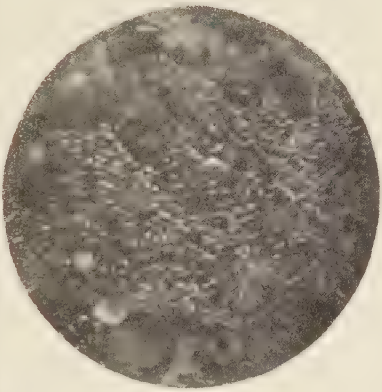


FIG. 2. Micrograph of oriented chalcopyrite inclusions in stannite which has been etched; Cornwall, England. Magnification 130 X.

The earliest minerals to crystallize were pyrite and arsenopyrite which occur as more or less corroded and isolated grains. In one case pyrite was completely enclosed by arsenopyrite as if of somewhat earlier origin, but, in general, the two are contemporaneous and are surrounded by stannite. Wolframite was found in several specimens and is apparently earlier than stannite as the latter mineral is found cutting or enclosing it. Chalcopyrite is apparently contemporaneous and also later than stannite. It is the most characteristic associated mineral and occurs as irregular areas, minute inclusions, and veinlets in the stannite; also as borders along the contact of stannite with other minerals in a manner indicating a late formation. In general, the disseminated chalcopyrite appears to be contemporaneous with the stannite and under high power the inclusions appear to be aligned with the crystal structure of the stannite. (See Fig. 2.)

---

[5] Davy, W. M., Ore deposition in the Bolivian tin-silver deposits. *Econ. Geol.*, **15**, 463-496, 1920.

Sphalerite occurs in a manner similar to that of chalcopyrite except that there is less definite evidence of its formation later than stannite. The two are probably nearly contemporaneous. On the polished surfaces of the Tasmanian specimens a white mineral occurs as a distinctly later generation than the stannite. It is found principally as veinlets, in many places with chalcopyrite, and is clearly a replacement as residual grains of stannite remain in it. The mineral did not occur in large enough amounts to enable a blowpipe determination but microchemical tests indicated it to be frankeite, ($Pb_5Sn_2Sb_2S_{12}$). If the identification is correct the order is the reverse of that found by Davy in the Bolivian deposits where it preceded stannite.

CONCLUSIONS

The following points have been brought out by this study. Stannite has characteristic included minerals which are practically the same for various regions. The paragenesis and relations of these included minerals are also uniform for the various districts. The paragenesis is, as a rule, pyrite and arsenopyrite, wolframite, stannite and sphalerite, chalcopyrite, frankeite. Stannite, sphalerite, and chalcopyrite are in part contemporaneous. The above facts indicate that stannite is formed under rather definite and limited conditions which accounts for its occurrence in but few places. Analyses of stannite given by Dana show a variable zinc content. Stelzner gives an analysis of Bolivian stannite which has less than 1% zinc. The fact that inclusions of sphalerite are common in the Cornwall occurrence suggests that the zinc content may be due to inclusions rather than to zinc in the molecule. Other irregularities of composition may be explained in this manner as the inclusions may be very minute and would escape detection except under high magnification.

NOTES AND NEWS

A NEW OCCURRENCE OF SAPPHIRINE. Ernest E. Fairbanks. *Somerville, Mass.*

A mineral pleochroic in green and blue tones was found in sillimanite-cordierite schist from Cortlandt, New York, in the collection of the Massachusetts Institute of Technology, which proved to be sapphirine. This mineral was identified by its refractive indices, which were very close to those found by Dr. Warren for the St. Urbain, Quebec mineral,[1] by its biaxial negative character and its pleochroism. The sapphirine is abundant in the specimen of schist studied. The extensive literature on the Cortlandt series was examined for references to this mineral and a statement by Rogers[2] gives the impression that he may have observed this mineral but have mistaken it for corundum. Rogers states, in his description of the sillimanite-cordierite schist that "Corundum, in any of the three varieties, may be present * * * ." As I am not familiar with three varieties of corundum, I believe that the sapphirine may be included among these.

The sapphirine of this occurrence is a metamorphic mineral and it is unlikely that it is ever produced other than as a metamorphic product. Warren at first believed his sapphirine from St. Urbain to be of magmatic origin, but now considers that it is probably of metamorphic derivation.[3]

Dr. Oliver Bowles, mineral technologist of the Bureau of Mines, has been designated by the Secretary of the Interior as superintendent of the new mining experiment station of the bureau to be established at Rutgers College, New Brunswick, New Jersey. The new station will specialize in problems involved in the production and utilization of the various non-metallic minerals.

Dr. Richard B. Moore, chief chemist of the Bureau of Mines, has resigned and has been succeeded by Dr. Samuel C. Lind. Dr. Lind has for a number of years acted as superintendent of the Rare and Precious Metals Experiment Station of the bureau at Reno, Nevada.

PROCEEDINGS OF SOCIETIES

NEW YORK MINERALOGICAL CLUB

Regular Monthly Meeting of May 16, 1923

A regular meeting of the New York Mineralogical Club was held in the Morgan Memorial Hall of Minerals and Gems of the American Museum of Natural History on the evening of May 16th at 8 P. M. The Vice President, Mr. George E. Ashby, presided and there was an attendance of 18 members.

In discussing the subject of the Decoration Day Excursion the Secretary read a letter from Professor J. Volney Lewis relative to the Copper Mine locality at Griggstown, two miles north of Rocky Hill, N. J., and also a letter from Mr. O.

---

[1] Warren, C. H., The ilmenite rocks near St. Urbain, Quebec; a new occurrence of rutile and sapphirine. *Am. Jour. Sci.*, **33**, 274, 1912.

[2] Rogers, G. Sherburne, Geology of the Cortlandt series and its emery deposits. *Annals N. Y. Acad. Sci.*, **21**, 72, 1911.

[3] Personal communication.

Ivan Lee describing a visit to a limestone cave near Peapack, Somerset County, N. J. Mr. Manchester suggested the Bedford Feldspar Quarries as a possible objective for the Decoration Day Excursion of the Club. By a vote of the members present the Bedford Quarries locality was decided upon and the Secretary instructed to issue notices to this effect.

The Committee on Membership reported favorably on the following names:—Dr. C. A. H. Smith, 342 Madison Ave., New York City; and Dr. W. B. Short, 342 Madison Ave., New York City. On a motion by the chair the Secretary cast a ballot for these gentlemen who were declared elected. The Secretary then moved that the names of Professor A. Lacroix of the University of Paris, France, and Dr. Victor Goldschmidt of Heidelberg University, Germany, be added to the list of Honorary members of the Club. This motion was carried.

The Secretary read a letter from the Mayor's Committee on the Celebration of the Twenty-fifth Anniversary of the Greater City of New York, requesting the Club to furnish a Representative on this committee. The President, Dr. George F. Kunz, was selected to represent the Club. The Secretary, as part of the evening's program, exhibited a number of new accessions to the Collection of the American Museum. Among these of special interest were several type specimens of calcite from Rhisnes and Chokier, Belgium, with the original labels in the handwriting and signed by Professor G. Césaro; some of these were also lettered on the crystal faces by the same investigator. In this series were also fine specimens of crystallized smithsonite and willemite from the original locality, Moresnet, Belgium, and destinezite from Argenteau, Belgium, having the labels signed by M. Destinez, after whom the variety was named. After an inspection of the collections installed in the Morgan Hall, the meeting adjourned.

HERBERT P. WHITLOCK, *Recording Secretary*

BOOK REVIEW

GUIDE TO THE COLLECTION OF GEMSTONES IN THE MUSEUM OF PRACTICAL GEOLOGY. W. F. P. McLintock. Second edition. 80 pages. 1923. Printed under the Authority of His Majesty's Stationery Office, *London.* Price 1 *s* net.

While a few of the old illustrations have been discarded or replaced by new drawings of a more suitable character, the second edition of this guide conforms in its main features to the first. It not only describes the specimens in the Museum but also devotes 33 pages to a general discussion, in non-technical terms, of the properties of gemstones, the methods of identifying them, the various styles of cutting and the processes employed for their artificial production and imitation.

As the treatment is general, aside from the references to cases where the specimens are exhibited, the pamphlet may be used to good advantage as a guide to any collection of gemstones or as a brief introduction to the study of gem minerals.

Copies may be obtained from E. Stanford, Ltd., 12, 13, and 14 Long Acre, London, W. C. 2; or from the Director General, Ordnance Survey, Southampton.

W. F. H.

NEW MINERALS: DOUBTFUL SPECIES

CLASS: SULFIDES, ETC. DIVISION: $R'': R''': S=3:8:15$?.

"Keeleyite"

Samuel G. Gordon: Keeleyite, a new lead sulfantimonite from Oruro, Bolivia. *Proc. Acad. Nat. Sci. Phila.*, **74**, 101-103, 1922.

Name: In honor of Mr. Frank J. *Keeley*, Curator of the William S. Vaux collection.

Chemical properties: *Formula*, considered to be $2PbS.3Sb_2S_3$ or $Pb_2Sb_6S_{11}$. This is based on analysis by J. E. Whitfield of a rather impure specimen, which showed: Pb 25.80, Sb 43.46, Cu 2.25, Fe 2.77, S 24.54, quartz by difference 1.18%; (some Sn probably weighed with the Sb). From this 8.15% of "sulfides" (presumably calculated as chalcopyrite) were deducted, giving on recalculation Pb 28.43, Sb 47.88, S 23.69, sum 100.00%. This lies about equally distant between the theories for $2PbS.3Sb_2S_3$ and $3PbS.4Sb_2S_3$. However, the uncertainty connected with the subtraction of the constituents of the indeterminate sulfides renders it impracticable to decide between these two formulas. In this connection it is noteworthy that some analyses of the mineral zinkenite (including that from the type locality) show more antimony and less lead than the usually assigned formula ($PbS.Sb_2S_3$) requires, and approach $3PbS.4Sb_2S_3$. The chemical data are therefore insufficient to distinguish "keeleyite" from zinkenite. Before the blowpipe gives the usual lead sulfantimonite reactions.

Crystallographic and physical properties: Form, radiating acicular crystals, probably orthorhombic. Color, dark gray; streak, grayish black. H. = 2; sp. gr. = 5.21 ±. No mineragraphic data given. These properties do not differentiate "keeleyite" from zinkenite.

Occurrence: In cavernous quartz with pyrite, stannite, and other sulfides in the silver-tin mines at Oruro, Bolivia.

Discussion: The data seem inadequate to establish this as a species distinct from zinkenite, altho the composition of the latter is not settled. Zinkenite may comprise two species, the original one having the same formula as "keeleyite," and another being $PbS.Sb_2S_3$ which would require a new name.

E. V. Shannon

CLASS: PHOSPHATES, ETC. DIVISION: $R'':As:(H_2O)=5:2:6$(?)

"Acrochordite"

Gust. Flink: Akrochordit, ett nytt mineral från Långbans Gruvor. (Acrochordite, one of the new minerals from the Långban Mines). *Geol. Fören. Förh.*, **44**, No. 6-7, pp. 773-776, 1922. (Swedish, with partial English summary.)

Name: From the Greek *akrochordon*, a wart, referring to the aspect of aggregates of the mineral.

Chemical properties: Formula $5(Mn, Mg)O.As_2O_5.6H_2O$ or $(Mn, Mg)_5(OH)_4(AsO_4)_2(H_2O)_4$. Theory, for Mn:Mg = 4:1 (as approximately found), MnO 42.8, MgO 6.1, As_2O_5 34.7, H_2O 16.4, sum 100.0%. Analysis by G. K. Almström gave: MnO 38.98, Mn_2O_3 0.50, FeO 0.46, CaO 0.99, MgO 6.94, K_2O 0.55, Na_2O 1.18, As_2O_5 33.51, P_2O_5 0.42, H_2O 16.78, sum 100.31%. These figures were obtained on several small amounts of material.

Dissolves readily in dilute H_2SO_4, the solution showing a purple color owing to the presence of manganic Mn, which indicates moreover that the As must be in the arsenic state. On heating the mineral loses water and becomes grayish black.

Crystallographic and optical properties (determined by P. Quensel): System monoclinic, altho the angles are not measurable with sufficient accuracy to yield the constants. Optic axial plane perpendicular to the symmetry plane, with $X=b$ and $Y:c=40°$; dispersion, red less than violet. Nearly colorless in thin section, without pleochroism. [Unfortunately the refractive indices are not recorded.]

Physical properties: Color red brown with a peculiar yellowish tint; subtranslucent. Form, aggregates of minute sub-parallel crystals. H.=4.5, sp. gr=3.194.

Occurrence: In small amount in druses lined with unusually stable pyrochroite crystals and barite crystals. Found several years ago in the "Japan" workings of the Långban mines, at a depth of about 100 meters.

Discussion: This analysis is rather close to those recorded for "chondrarsenite" and "xantharsenite"; the former of these was later found to be identical with sarkinite, but the latter has not been studied by modern methods. In the absence of a chemical analysis made on adequate material, of definite crystallographic data and of refractive index determinations, the distinctness of the present mineral can hardly be regarded as satisfactorily established. E. T. W.

Acrochordite

G. Karl Almström: Om akrochorditens kemiska sammansättning. (The chemical composition of acrochordite.) *Geol. För. Förh.*, 45, 117-118, 1923.

Chemical properties: It is believed that the material analyzed by Flink in announcing this new species (see abstract above) was impure, containing central nuclei of pyrochroite. The formula is accordingly probably simply $Mn_4Mg(AsO_5)_2.6H_2O$. It appears to be analogous to tyrolite and other copper arsenates, which have the same base-acid ratios but range widely in water content.

E. T. W.

CLASS: SILICATES. DIVISION: $R'':R'':SiO_2:(F,OH)=1:1:2:X$.

Mansjoeite

Harry von Eckermann: The rocks and contact minerals of the Mansjö Mountain. *Geol. För. Förh.*, 44, (3-4), 203-410; this mineral, 355-358, 1922.

Name: From the locality, *Mansjö*. [The English equivalent should be spelled mansjoeite.]

Chemical properties: Analysis by Sahlbom gave: SiO_2 50.14, TiO_2 none, Al_2O_3 0.95, Fe_2O_3 0.91, FeO 7.45, MnO 0.08, CaO 21.26, MgO 17.10, K_2O 0.07, Na_2O 0.24, P_2O_5 0.03, F 0.63, H_2O+ 0.76, sum 99.62 or less O=F 0.26, sum 99.46%. Recalculation according to the usual plan shows about 58% diopside, 26 hedenbergite, 2 each "acmite" and "augite" (Tschermak) and a remainder of 12% with the approximate ratios of chondrodite. [The simplest formula which can be written for it is $Ca(Mg, Fe)(SiO_3)_2+x\,Mg(OH, F)_2$ with $x=$about $\frac{1}{8}$; the evidence that a chondrodite molecule is present is not considered by the abstractor to be adequate, because the rôle of the Al, Fe''', etc. is not really known].

Physical properties: Color grayish green; in thin section colorless. Luster vitreous; structure granular; cleavage prismatic; sp. gr. 3.236. Shows some gas-filled inclusions.

OPTICAL PROPERTIES: Biaxial, +; $\alpha=1.675$, $\beta=1.682$, $\gamma=1.704$, $\gamma-\alpha=0.029$; $2V=58° 20'$. Dispersion strong. The orientation shows the crystallization to be monoclinic, the maximum extinction angle $c:\gamma$ being 35°.

OCCURRENCE: In contact metamorphic limestone, probably formed by the action of fluorine-bearing residual solutions from the magma. Many so-called coccolites are probably similar in origin, and may also contain fluorine or chlorine which have been overlooked. The mineral associates are: calcite, pargasite, prehnite, phlogopite, titanite, and apatite.

DISCUSSION: Whether this mineral deserves a species name is doubtful; the abstractor would prefer to call it *fluoriferous diopside*, until further data are obtained. E. T. W.

REDEFINITION OF SPECIES

CLASS: SILICATES. DIVISION: ACID ZEOLITES

"Flokite" (Callisen, 1917) = **Mordenite** (How, 1864).

Ptilolite (Cross and Eakins, 1886) is distinct from **Mordenite.**

Clinoptilolite, new name for "crystallized mordenite."

O. B. BØGGILD: Re-examination of sôme zeolites. *Kgl. Danske Vidensk. Selsk., Math.-fys. Medd.*, **4,** No. 8, 42 pp., 1922; these minerals, p. 19. T. L. WALKER and A. L. PARSONS: The zeolites of Nova Scotia. *Univ. Toronto Studies, Geol. Series,* No. **14,** 13–73, 1922; these minerals (by T. L. W.), p. 61. W. T. SCHALLER: Ptilolite and related zeolites. Paper presented before Mineralogical Society of Washington, Feb. 23rd, 1923; (see page 93 of this journal).

DISCUSSION: Disregarding the inclined extinction and differences in composition, Bøggild considers "flokite" identical with ptilolite; Schaller finds it to agree in composition and optics with mordenite. Walker suggests that ptilolite is "probably identical with mordenite"; the new data cited by Schaller do not bear this out. Schaller shows clearly that on chemical and optical grounds three species are comprised in this group: Mordenite, ptilolite and clinoptilolite. E. T. W.

ABSTRACTS: CRYSTALLOGRAPHY

ON THE OCCURRENCE OF PHENACITE AND SCHEELITE AT WHEAL COCK, ST. JUST, CORNWALL. ARTHUR RUSSELL. *Mineral. Mag.*, **19,** [88], 19-22, 1920.

The phenacite crystals occur either attached to iron-stained quartz prisms or are embedded in a partially altered chlorite, associated with crystals of scheelite, cassisterite and orthoclase. The following forms were observed on the phenacite: $(11\bar{2}0)$, $(10\bar{1}0)$, $(10\bar{1}1)$, $(01\bar{1}2)$, $(11\bar{2}3)$, $(3\bar{1}\bar{2}1)$, $(\bar{1}3\bar{2}2)$. In an early British Mineralogy (J. Sowerby, 1809, Vol. 4, pp. 53-54) phenacite crystals from this locality were erroneously described as "white tourmaline." The crystals of scheelite occurring with the phenacite measure at times 1½ cm in length and are of the simple bipyramidal habit, consisting of but two forms, (101) and (001).

W. F. H.

NEW CRYSTAL FORMS ON PYRITE, CALCITE, AND EPIDOTE. L. J. SPENCER. *Mineral. Mag.*, **19,** [88] 1-9, 1920.

The identity of the dyakisdodecahedron, (641), on pyrite, observed on only two previous occasions, is now firmly established by measurements on three additional crystals. In a table representing a crystallographic study of 424 specimens, 35 crystal forms are listed, together with the number of specimens on which each form was found. The scalenohedron $(12.7.\overline{19}.5)$ and the pyramid $(\overline{1}34)$ are new forms for calcite and epidote, respectively. W. F. H.

A SUPPOSED TWIN OF COPPER SULFATE. O. Haas. *Bull. soc. franc. min.*, **43**, 228-232, 1920.

Haas shows that the supposed twins of $CuSO_4+5H_2O$ described by Boeris in 1905, are parallel groupings on (010) with the relation of the face (001) of one individual to the face (100) of the other accidentally close to parallelism in Boeris' specimen. E. F. H.

THE CRYSTALLOGRAPHIC CHARACTERS OF INOSITO-HEXAPHOSPHATE OF SODIUM. A. Sabot. *Bull. soc. franc. min.*, **43**, 296-300, 1920.

Crystals are monoclinic, habit prismatic, $\beta=108°13'$, $a:b:c=0.630:1:0.639$. Plane of opt. axes perpendicular to b (010); bx_a approx. perpendicular to c (001); opt. ax. angle about 90°; sign +; birefr. high. E. F. H.

TWO GEOMETRICAL CONSTRUCTIONS FOR DRAWING STEREOGRAPHIC PROJECTIONS. A. Duffour. *Bull. soc. franc. min.*, **43**, 5-8, 1920.

Construction I. Having given the projection of two faces, to find, without tracing the zone of those two faces, the diameter common to the fundamental circle and to the zone of the two faces.

Construction II. Having given the projection of a zone, to find its intersection with a second zone, not traced, but defined by the projection of two faces.

C. B. S.

CONTRIBUTION TO THE GEOMETRIC STUDY OF TWINS. G. Freidel. *Bull. soc. franc. min.*, **43**, 246-294, 1920.

A mathematical discussion of the structure and symmetry of twins, especially those producing pseudosymmetric forms. E. F. H.

CONTRIBUTION TO THE STUDY OF THE OPTICAL PROPERTIES OF CERUSSITE. P. Sève. *Bull. soc. franc. min.*, **43**, 9-22, 1920.

As determined from photographs of the interference figures of cerussite, the optic axial angle in air varies from 16° for light of 360 $\mu\mu$, in the ultraviolet, through 0° for 415$\mu\mu$, to 19° for 770$\mu\mu$ in a plane perpendicular to that of the optic axes for ultraviolet. Data on the variation of $\gamma-\beta$ for various wave lengths is also given.

E. F. H.

ATOPITE FROM MIGUEL BURNIER, MINAS GERAES, BRAZIL. H. Rose. *Centr. Min. Geol.*, 268-271, 1919.

Isometric crystals showing *o*, *d*, *h*, and *i* were measured. The value n_{Na} averaged 1.836 on three prisms. E. F. H.

THE ELASTICITY CONSTANTS OF SYLVITE. K. Försterling. *Z. Physik*, **2**, 172-4, 1920.

New values are determined which agree well with the theoretical values, as determined from the molecular theory of crystals. E. F. H.